

CRICKET FROG (AMPHIBIA: ANURA: DICROGLOSSIDAE): TWO REGIONS OF ASIA ARE CORRESPONDING TWO GROUPS

Mohammad Sajid Ali Howlader

Herpetology Laboratory' Bangladesh, Society for Research and Development (SRD), 28/5 Shonatangar,
Jigatola, Dhaka 1209, Bangladesh. Email: sajidpabc@gmail.com

Abstract. Cricket frogs are widely distributed throughout South and Southeast Asia. They are divided into two distinct clades based on phylogenetics and morphology: South Asian morph and Southeast Asian morph. Morphologically, they can also be classified according to their distribution pattern. Herein, South Asian Cricket frogs are grouped under *Zakerana*, a new genus.

Key words: Amphibia, Cricket frog, *Fejervarya*, *Zakerana* gen. nov.

Cricket frog is nominated as *Fejervarya* Bolkay, 1915. Presently, the genus is exhibiting 32 species distributed throughout South and Southeast Asia. After analyzing the phylogenetic data, Frost et al. (2006) assigned *Fejervarya* with *Hoplobatrachus* Peters, 1863, *Euphlyctis* Fitzinger, 1843, *Nannophrys* Günther, 1869 and *Sphaerotheca* Günther, 1859. Morphometric nature of the *Fejervarya* species are much problematic (Kotaki et al., 2010) and several cryptic species have been found from *Fejervarya* populations formerly recognized as single nominal species (Dubois, 1975; Toda et al., 1998; Veith et al., 2001; Sumida et al., 2007; Islam et al., 2008a, 2008b). About the half of *Fejervarya* species were described in the 19th century and early 20th century (Frost, 2011). Those specimens and literatures are difficult to get access to. Due to the presence of huge morphological variation, but lack of information, most of the South Asian taxonomist designated their specimens as *Fejeravrya limnocharis* (Gravenhorst, 1829) complex. *F. limnocharis* is confined to Indonesia, Malaysia, Laos and Vietnam (Toda et al., 1998; Biju, 2001; Veith et al., 2001; Djong et al., 2007). To avoid the taxonomic caucus authors had to use only geographical or morphological congeners to compare their new species (Howlader, 2011; Kuramoto et al., 2007; Stuart, et al., 2006) and most of them could not present detailed comparison (Matsui, et al., 2007, Dutta, 1997). Studies of Kosuch et al. (2001; based on 572-bp sequences of the 16S rRNA gene); Frost et al. (2006; part of a cladogram, presented on page 136); Sumida et al. (2007; based on nucleotide sequences of a 422-bp segment of the

mitochondrial 16S rRNA gene); Kotaki et al. (2008); based on 638 bp of the mitochondrial 16S and 12S rRNA genes); Wiens et al. (2009; two mitochondrial, three nuclear); Kotaki et al. [2010; based on 6364 bp of the mitochondrial (*Cytb*, *12S*, and *16S*) and nuclear genes (*BDNF*, *CXCR4*, *NCX1*, *RAG-1*, *RAG-2*, *Rhod*, and *Tyr*)] also reflect *Fejervarya* as two distinct groups, viz. South Asian and Southeast Asian. However, none of the above mentioned authors presented any morphological comparison of the two groups. Herein, South Asian group is represented as separate genus from *Fejervarya*. Southeast Asian group (*Fejervarya limnocharis* group) is treated here as *Fejervarya*, because *F. limnocharis* is representing type species of *Fejervarya*. A brief diagnosis, distribution ranges and list of coined species under the proposed new genus are presented here.

South Asian Cricket frog: *Zakerana* gen. nov. (Type Species: *Rana limnocharis syhadrensis* Annandale, 1919).

Etymology: Zaker + Latin: *rana* [frog] reflects the contributions to wildlife conservation by Professor Kazi Zaker Husain [1933-2011], founder of Wildlife Biology in Bangladesh.

Diagnosis: *Zakerana* gen nov. may be characterized as a group of small-sized frogs having snout not much pointed or slightly rounded; relatively small tympanum; small rounded or slightly elongated, laterally compressed internal metatarsal tubercles; rudimentary webbing on feet; and small tibia.

The snout-vent length and rudimentary webbing on the feet *Zakerana* correspond to *Minervarya* Dubois, Ohler, and Biju, 2001, but absence of rictal gland and large number of tubercles in *Zakerana* separate them from *Minervarya*. Small body size, not much pointed or slightly rounded snout, relatively small tympanum, small internal metatarsal tubercles, rudimentary webbing on feet, and small tibia distinguish *Zakerana* from *Fejervarya* (Table 1).

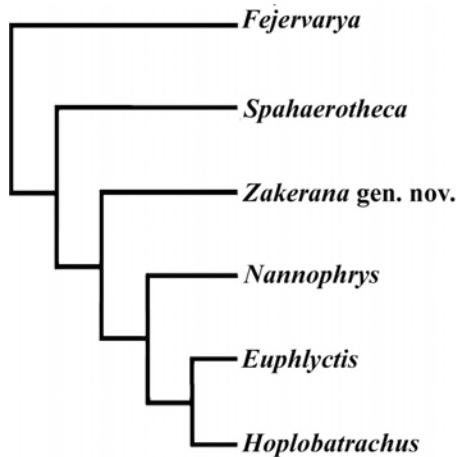


Figure 1. Cladistic relationship to distinguish the position of *Zakerana* gen. nov. with congeners (redrawn from Frost et al., 2006; Fig. 63. *Zakerana*, presented here instead of *Fejervarya syhadrensis* and *F. kirtisinghei*; other genera for their own species.)

Cladistic relationships: Based on phylogenetics, Frost et al. (2006) nested *Fejervarya* with *Hoplobatrachus*, *Euphlyctis*, *Nannophrys*, and *Sphaerotheca* (Figure 1). The presence of Fejervaryan line is a synapomorphic character among *Fejervarya*, *Zakerana* and *Minervarya*, I think. Hence, they are sister genera. However, *Zakerana* and *Minervarya* are hypothesized to have a common origin for their common habitats in South Asia and small body size with rudimentary webbing on feet. Molecular work will be presented on another paper to clarify the hypothesis.

Species contents: *Zakerana brevipalmata* (Peters, 1871) comb. nov.; *Zakerana caperata* (Kuramoto, Joshy, Kurabayashi, and Sumida, 2007) comb. nov.; *Zakerana granosa* (Kuramoto, Joshy, Kurabayashi, and Sumida, 2007) comb. nov.; *Zakerana greenii* (Boulenger, 1905) comb. nov.; *Zakerana keralensis* (Dubois, 1981) comb. nov.; *Zakerana kirtisinghei* (Manamendra-Arachchi and Gabadage, 1996) comb. nov.; *Zakerana kudremukhensis* (Kuramoto, Joshy, Kurabayashi, and Sumida, 2007) comb. nov.; *Zakerana mudduraja* (Kuramoto, Joshy, Kurabayashi, and Sumida, 2007) comb. nov.; *Zakerana murthii* (Pillai, 1979) comb. nov.; *Zakerana mysorensis* (Rao, 1922)

comb. nov.; *Zakerana nepalensis* (Dubois, 1975) comb. nov.; *Zakerana nilagirica* (Jerdon, 1854) comb. nov.; *Zakerana parambikulamana* (Rao, 1937) comb. nov.; *Zakerana pierrei* (Dubois, 1975) comb. nov.; *Zakerana rufescens* (Jerdon, 1854) comb. nov.; *Zakerana sauriceps* (Rao, 1937) comb. nov.; *Zakerana syhadrensis* (Annandale, 1919) comb. nov.; *Zakerana teraiensis* (Dubois, 1984) comb. nov.; and *Zakerana asmati* (Howlader, 2011) comb. nov.

Distribution: All species of *Zakerana* are reported from South Asian countries like Bangladesh, India, Nepal, Pakistan, and Sri Lanka (Frost, 2011).

Remarks: Formation of geographical barriers and climatic fluctuations are the main causes of speciation (Mayr, 1942; Hewitt, 2000). Uplift of mountain systems and the development of river systems might have been formulating barriers to gene flow between populations, resulting in diversification along these boundaries (Nielson and Wakeley, 2001; Brant and Ortí, 2003; Carstens et al., 2004; Funk et al., 2005; Steele et al., 2005; Howes et al., 2006; Kozak et al., 2006; Lemmon et al., 2007). Main land of South Asia is separated from Southeast Asia and East Asia by series of mountains (Himalayan Mountains, Arakan Mountains, Patkai Mountains) and Indian ocean (Figure 2) which might have contributed to allopatric and parapatric speciation. South Asian species are showing significant level of genetic and some morphological variations from Southeast Asian frogs (Toda et al., 1998; Biju, 2001; Veith et al., 2001; Djong et al., 2007; Kuramoto et al., 2007; Alam et al., 2008; Joshy et al., 2009; Kotaki et al., 2010). Recently, South Asian species are nested some new genus (like *Raorchestis*, *Minervarya* and *Duttaphrynus*) for their endemism (Dubois et al., 2001; Frost et al., 2006; Biju et al., 2010). *Zakerana* gen. nov. is presented here for the South Asian species groups that was belonging to *Fejervarya*. However, there is one exceptional species, *F. orissaensis* representing morphological character like Southeast Asian group (Dutta, 1997) and not coined on the new genus. Kurniawan et al. (2010) suggested that *Fejervarya cancrivora* is exhibiting three morphotypes: mangrove type (India, Bangladesh, Thailand, and Philippines), large type (Malaysia and Indonesia), and Pelabuhan ratu / Sulawesi type (Southeastern Indonesia). Herein, mangrove type (South Asian) is considered as *F. cancrivora* species complex instead of *F. cancrivora* for their localities, habitat ecology and smaller size than the type locality. According to Gravenhorst (1829) *Rana cancrivora* (*F. cancrivora*) is “larger” than *R. limnocharis* (*F. limnocharis*), and the name *R. cancrivora* has been

consistently applied to large individuals in the *R. limnocharis* complex occurring in Java and neighboring regions. South Asian mangrove type (*F. cancrivora* complex) should be concluded on several taxa.

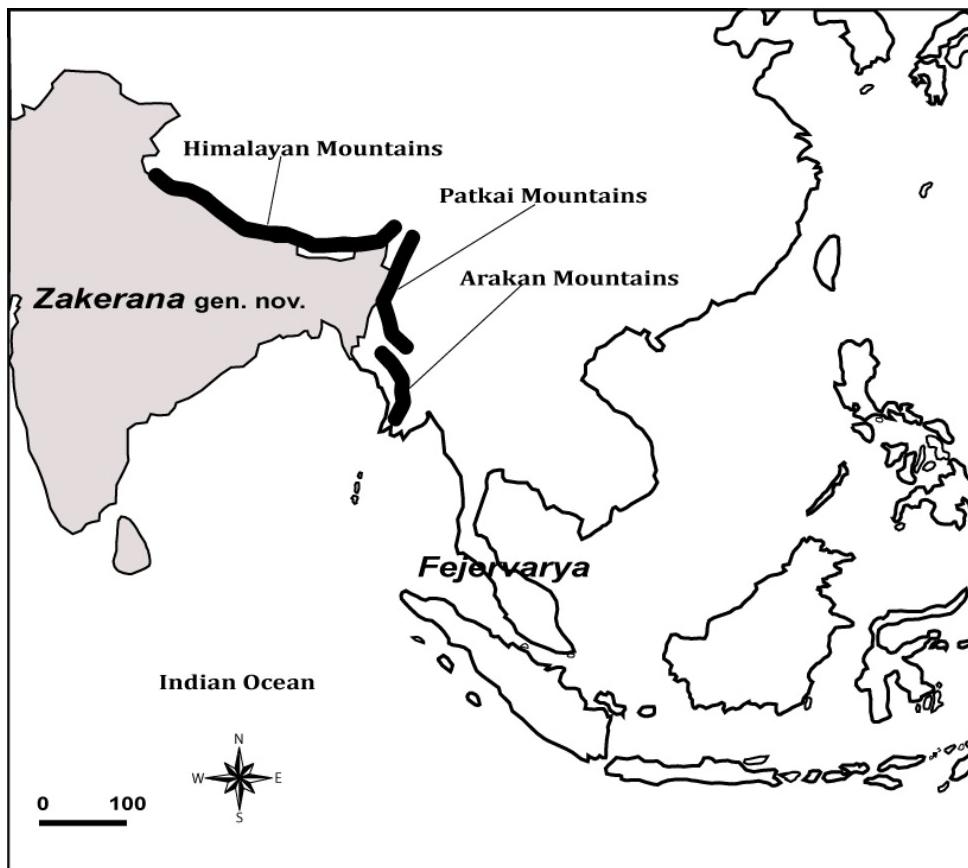


Figure 2. Distribution of *Zakerana* gen. nov. and *Fejervarya*.

Acknowledgments. I am grateful to Qamar Banu (Asian University for Women, Chittagong, Bangladesh) for improving the manuscript. I would like to thank Robert F. Inger (Division of Amphibians and Reptiles, The Field Museum of Natural History, USA), Aaron M. Bauer (Villanova University, Pennsylvania, USA), Rafe M. Brown (KU Biodiversity Institute, University of Kansas, USA), Scott Keogh (Division of Evolution, Ecology and Genetics, The Australian National University, Australia), Gad Perry (Department of Natural Resource Management, Texas Tech University, USA), Miguel Vences (Technische Universitaet Braunschweig, Zoological Institute, Germany), Wolfgang Böhme (Zoologisches Forschungsmuseum Alexander Koenig, Germany), Alexander Haas (University of Hamburg, Biozentrum Grindel und Zoologisches Museum, Germany), Eli Greenbaum (Laboratory for Environmental Biology, University of Texas at El Paso, USA), Jonathan Losos (Museum of Comparative Zoology and Department of

Organismic and Evolutionary Biology, Harvard University, USA), James Hanken (Museum of Comparative Zoology, Harvard University, USA), Richard M. K. Saunders (School of Biological Sciences, The University of Hong Kong, Hong Kong), Paul Harvey (Department of Zoology, University of Oxford, UK), and Eric N. Smith (Amphibian and Reptile Diversity Research Center, The University of Texas at Arlington, USA) for their views in preparing the manuscript. Annemarie Ohler (Muséum national d'Histoire naturelle, Département Systématique et Évolution, France), Masafumi Matsui (Graduate School of Human and Environmental Studies, Kyoto University, Japan) and José A. Langone (Departamento de Herpetología, Museo Nacional de Historia Natural y Antropología, Montevideo, Uruguay) are acknowledged for providing some important articles. I thank Abdur Razzaque (Herpetology Laboratory, Bangladesh) for his helpful suggestions.

Table 1. Comparison of morphological characters of *Zakerana* gen. nov. with its congeners.

Characters	<i>Zakerana</i> gen. nov. 1915	<i>Feijervarya Bolkay,</i> 2001	<i>Mnervarya Dubois,</i> Oller and Biju, 2001	<i>Sphaerotheca</i> Günther, 1859	<i>Euphyctis</i> Fitzinger, 1843	<i>Hoplobatrachus</i> Peters, 1863	<i>Nannophrys</i> Günther, 1869
SVL (Adult male)mm	22–36	38–80	17–21	30–55	40–95	75–130	24–37
SVL (Adult female)mm	23–45	45–90	20–23	35–60	45–130	65–140	26–46
Snout	Slightly pointed	Pointed	Slightly pointed	Slightly rounded	Slightly pointed	pointed	Rounded
Rictal gland	Absent	Absent	Present	Absent	Absent	Absent	---
Webbing on feet	Rudimentary	Small to medium	Rudimentary	small	Complete	Large	Free or basal trace
Internal metatarsal tubercle	Small, rounded or slightly elongated, laterally compressed	More wider, rounded	Rather long, cylindrical	Short, shovel-shaped	Pointed, cylindrical, digit-like	Rather long, cylindrical or shovel-shaped	Elongated
Dorsal skin	With several longitudinal folds arranged on regular form	Interrupted longitudinal folds	With several longitudinal folds	Smooth	Smooth with horny granules	More arranged longitudinal folds	Warty
Lateral line system in adult	Absent	Absent	Absent	Absent	Present	Absent	---
Feijervarya lines	Present	Present	Present	Absent	Absent	Absent	Absent
Femoral glands	Absent	Absent	Absent	Absent	Absent	Absent	Data not found
Tympantan diameter	Small	Large	Small	medium	medium	Large	Lage
Tibia length (relative to the SVL)	Approximately half of SVL	More or less equal to SVL or nearest value to SVL	Approximately half of SVL	---	Approximately half of SVL	---	Larger than SVL
References for characters	Boulenger, 1890; Rao, 1922; 1937; Pillai, 1979; Dutta and Manamendra-Arachchi, 1996; Dutta, 1997; Chanda, 2002; Stuart et al., 2006; Borthakur et al., 2007; Kuramoto et al., 2007; Matsui et al., 2007; Rasel et al., 2007	Boulenger, 1890; Rao, 1922; 1937; Pillai, 1979; Dutta and Manamendra-Arachchi, 1996; Dutta, 1997; Chanda, 2002; Stuart et al., 2006; Borthakur et al., 2007; Kuramoto et al., 2007; Matsui et al., 2007	Dubois et al., 2001; Oller et al., 2009.	Boulenger, 1920; Kirtisinghe, 1957; Dutta and Manamendra-Arachchi, 1996.	Boulenger, 1920; Dutta and Manamendra-Arachchi, 1996; Khan, 1997; Joshy et al., 2009.	Boulenger, 1920; Fie et al., 1991; Fei, 1999; Chanda, 2002.	Clarke, 1983; Fernando et al., 2007

REFERENCES

- Alam, M.S., T. Igawa, M.M.R. Khan, M.M. Islam, M. Kuramoto, M. Matsui, A. Kurabayashi, and M. Sumida. 2008. Genetic divergence and evolutionary relationships in six species of genera *Hoplobatrachus* and *Euphlyctis* (Amphibia: Anura) from Bangladesh and other Asian countries revealed by mitochondrial gene sequences. Molecular Phylogenetics and Evolution, 48: 515–527.
- Biju, S.D. 2001. A synopsis of the frog fauna of the Western Ghats, India. Occasional Papers of the Indian Society of Conservation Biology, 1: 1–24.
- Biju, S.D., Y. Shouche, A. Dubois, S.K. Dutta and F. Bossuyt. 2010. A ground-dwelling rhacophorid frog from the highest mountain peak of the Western Ghats of India. Current Science, 98: 1119–1125.
- Borthakur, R., J. Kalita, B. Hussain, and S. Sengupta. 2007. Study on the *Fejervarya* (Anura: Dicoglossidae) species of Assam. Zoos' Print Journal, 22: 2639–2643.
- Boulenger, G.A. 1890. The fauna of British India. Including Ceylon and Burma. Reptilia and Batrachia. Taylor And Francis, Red Lion Court, Fleet Street, London, pp. 448–451.
- Boulenger, G.A. 1920. A monograph of the South Asian, Papuan, Melanesian, and Australian frogs of the genus *Rana*. Record Indian Museum, Calcutta, 20: 1–226.
- Brant, S.V. and G. Ortí. 2003. Phylogeography of the northern short-tailed shrew, *Blarina brevicauda* (Insectivora: Soricidae): past fragmentation and postglacial recolonization. Molecular Ecology, 12: 1435–1449.
- Carstens, B.C., A.L. Stevenson, J.D. Degenhardt, and J. Sullivan. 2004. Testing nested phylogenetic and phylogeographic hypotheses in the *Plethodon vandykei* species group. Systematic Biology, 53: 781–792.
- Chanda, S.K. 2002. Handbook –Indian amphibians. Zoological Survey of India, Kolkata.
- Clarke, B.T. 1983. A morphological re-examination of the frog genus *Nannophrys* (Anura: Ranidae) with comments on its biology, distribution and relationships. Zoological Journal of the Linnean Society, 79: 337–398.
- Djong, T.H., M.M. Islam, M. Nishioka, M. Matsui, H. Ota, M. Kuramoto, M.M.R. Khan, M.S. Alam, A. De Silva, W. Khonsue, and M. Sumida. 2007. Genetic relationships and reproductive isolation mechanism among the *Fejervarya limnocharis* complex from Indonesia (Java) and other Asian countries. Zoological Science, 24: 360–375.
- Dubois, A. 1975. Une nouveau complexe despèces jumelles distinguées par le chant: les grenouilles de Népal voisines de *Rana limnocharis* Boie (Amphibiens, Anoures). Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Paris, 281: 1717–1720.
- Dubois, A., A. Ohler, and S.D. Biju. 2001. A new genus and species of Ranidae (Amphibia, Anura) from south-western India. Alytes, 19: 53–79.
- Dutta, S.K. 1997. A new species of *Limnonectes* (Anura: Ranidae) from Orissa, India. Hamadryad, 22: 1–8.
- Dutta, S.K., and K. Manamendra-Arachchi. 1996. Amphibian fauna of Sri Lanka. Wildlife Heritage Trust of Sri Lanka, Colombo.
- Fei, L. (ed.). 1999. Atlas of Amphibians of China. Zhengzhou Henan Publishing of Science and Technology.
- Fei, L., C. Ye and Y. Huang. 1991. Key to Chinese Amphibia. Scientific and Technological Literature Press. Chongqing, China. [In Chinese].
- Fernando, S.S., L.J.M. Wickramasingha, and R.K. Rodirigo. 2007. A new species of endemic frog belonging to genus *Nannophrys* Günther, 1869 (Anura: Dicoglossinae) from Sri Lanka. Zootaxa, 1403: 55–68.
- Frost, D.R. 2011. Amphibian Species of the World: an Online Reference. Version 5.5 (31 January, 2011). Electronic Database accessible at <http://research.amnh.org/vz/herpetology/amphibia/> American Museum of Natural History, New York, USA.
- Frost, D.R., T. Grant, J. Faivovich, R. Bain, A. Haas, C.F.B. Haddad, R.O. de S'a, S.C. Donnellan, C.J. Raxworthy, M. Wilkinson et al. 2006. The amphibian tree of life. Bulletin of the American Museum of Natural History, 297: 1–370.
- Funk, W.C., M.S. Blouin, P.S. Corn, B.A. Maxell, D.S. Pilliod, S. Amish, and F.W. Allendorf. 2005. Population structure of Columbia spotted frogs (*Rana luteiventris*) is strongly affected by landscape. Molecular Ecology, 14: 483–496.
- Gravenhorst, J.L.C. 1829. Deliciae Musei Zoologici Vratislaviensis. Fasciculus primus. Chelonios et Batrachia. Leipzig: Leopold Voss.

- Hewitt, G.M. 2000. The genetic legacy of the Quaternary ice ages. *Nature*, 405: 907–913.
- Howes, B.J., B. Lindsay, and S.C. Lougheed. 2006. Range-wide phylogeography of a temperate lizard, the five-lined skink (*Eumeces fasciatus*). *Molecular Phylogenetics and Evolution*, 40:183–194.
- Howlader, M.S.A. 2011. A new species of *Fejervarya* (Anura: Dicoglossidae) from Bangladesh. *Zootaxa*, 2761: 41–50.
- Islam, M.M., M.M.R. Khan, D.H. Tjong, M.S. Alam, and M. Sumida. 2008a. Genetic differentiation of the *Fejervarya limnocharis* complex from Bangladesh and other Asian countries elucidate by allozyme analyses. *Zoological Science*, 25: 261–272.
- Islam, M.M., N. Kurose, M.M.R. Khan, T. Nishizawa, M. Kuramoto, M.S. Alam, M. Hasan, N. Kurniawan, M. Nishioka, and M. Sumida. 2008b. Genetic divergence and reproductive isolation in the genus *Fejervarya* (Amphibia: Anura) from Bangladesh inferred from morphological observations, crossing experiments, and molecular analyses. *Zoological Science*, 25: 1084–1105.
- Joshy, S.H., M.S. Alam, A. Kurabayashi, M. Sumida, and M. Kuramoto. 2009. Two new species of the genus *Euphlyctis* (Anura, Ranidae) from southwestern India, revealed by molecular and morphological comparisons. *Alytes*, 26: 97–116.
- Khan, M.S. 1997. A new subspecies of common skittering frog *Euphlyctis cyanophlyctis* (Schneider, 1799) from Balochistan, Pakistan. *Pakistan Journal of Zoology*, 29: 107–112.
- Kirtisinghe, P. 1957. The Amphibia of Ceylon. Published by the author, Colombo, Ceylon.
- Kosuch, J., M. Vences, A. Dubois, A. Ohler, and W. Böhme. 2001. Out of Asia: Mitochondrial DNA Evidence for an Oriental Origin of Tiger Frogs, Genus *Hoplobatrachus*. *Molecular Phylogenetics and Evolution*, 21: 398–407.
- Kotaki, M., A. Kurabayashi, M. Matsui, M. Kuramoto, T.H. Djong and M. Sumida. 2010. Molecular Phylogeny of the Diversified Frogs of Genus *Fejervarya* (Anura: Dicoglossidae). *Zoological Science*, 27:386–395.
- Kotaki, M., A. Kurabayashi, M. Matsui, W. Khonsue, T.H. Djong, M. Tandon, and M. Sumida. 2008. Genetic divergences and phylogenetic relationships among the *Fejervarya limnocharis* complex in Thailand and neighboring countries revealed by mitochondrial and nuclear genes. *Zoological Science*, 25: 381–390.
- Kozak, K.H., R.A. Blaine and A. Larson. 2006. Gene lineages and eastern North American palaeodrainage basins: phylogeography and speciation in salamanders of the *Eurycea bislineata* species complex. *Molecular Ecology*, 15:191–207.
- Kuramoto, M., S.H. Joshy, A. Kurabayashi, and M. Sumida. 2007. The genus *Fejervarya* (Anura: Ranidae) in Central Western Ghats, India, with description of four new cryptic species. *Current Herpetology*, 26: 81–105.
- Kurniawan, N., M.M. Islam, T.H. Djong, T. Igawa, M.B. Daicus, H.S. Yong, R. Wanichanon, M.M.R. Khan, D.T. Iskandar, M. Nishioka and M. Sumida. 2010. Genetic divergence and evolutionary relationship in *Fejervarya cancrivora* from Indonesia and Other Asian countries inferred from allozyme and MtDNA sequence analyses. *Zoological Science*, 27: 222–233.
- Lemmon, E.M., A.R. Lemmon, and D.C. Cannatella. 2007. Geological and climatic forces driving speciation in the continental distributed trilling chorus frogs (Pseudacris). *Evolution*, 61: 2086–2103.
- Manamendra-Arachchi, K., and D. Gabadage . 1996. *Limnonectes kirtisinghei*, a new species of ranid frog from Sri Lanka. *Journal of South Asian natural history*, 2: 31–42.
- Matsui, M., M. Toda, and H. Ota. 2007. A new species of frog allied to *Fejervarya limnocharis* from the southern Ryukyus, Japan (Amphibia: Anura). *Current Herpetology*, 26: 65–79.
- Mayr, E. 1942. Systematics and the origin of species. Columbia University Press, New York.
- Nielsen, R., and J. Wakeley. 2001. Distinguishing migration from isolation: a Markov Chain Monte Carlo approach. *Genetics*, 158: 885–896.
- Ohler, A., K. Deuti, S. Grosjean, S. Paul, A.K. Ayyaswamy, M.F. Ahmed, and S.K. Dutta. 2009. Small-sized dicoglossids from India, with the description of a new species from West Bengal, India. *Zootaxa*, 2209: 43–56.
- Pillai, R.S. 1979. A new species of *Rana* (Family Ranidae) from Western Ghats, S. India. *Bulletin of the Zoological Survey of India*, 2: 39–42.
- Rao, C.R.N. 1922. Notes on Batrachia. *Journal of the Bombay Natural History Society*, 28: 439–447.
- Rao, C.R.N. 1937. On some new forms of Batrachia from S. India. *Proceedings of the Indian Academy Science*, 6: 387–427.
- Rasel, M.S.R., M.A. Hannan, and M.S.A. Howlader. 2007. Four new country records

- of *Fejervarya* Bolkay, 1915 (Amphibian: Anura: Dicoglossidae) from Bangladesh. Bonnoprani-Bangladesh Wildlife Bulletin, 4: 1–3.
- Steele, C.A., B.C. Carstens, A. Storfer, and J. Sullivan. 2005. Testing hypotheses of speciation timing in *Dicamptodon copei* and *Dicamptodon aterrimus* (Caudata: Dicamptodontidae). Molecular Phylogenetics and Evolution, 36: 90–100.
- Stuart, B.L., Y. Chuaynkern, T. Chan-ard, and R.F. Inger. 2006. Three species of frogs and a new tadpole from eastern Thailand. Fieldiana Zoology (NS), 111: 1–19.
- Sumida, M., M. Kotaki, M.M. Islam, T.H. Djong, T. Igawa, Y. Kondo, M. Matsui, D.S. Anslem, W. Khonsue, and M. Nishioka. 2007. Evolutionary relationships and reproductive isolating mechanisms in the rice frog (*Fejervarya limnocharis*) species complex from Sri Lanka, Thailand, Taiwan and Japan, inferred from mtDNA gene sequences, allozymes, and crossing experiments. Zoological Science, 24: 547–562.
- Toda, M., M. Matsui, M. Nishida, and H. Ota. 1998. Genetic divergence among southeast and east Asian populations of *Rana limnocharis* (Amphibia: Anura, with special reference to sympatric species in Java. Zoological Science, 15: 607–613.
- Veith, M., J. Kosuch, A. Ohler, and A. Dubois. 2001. Systematics of *Fejervarya limnocharis* (Gravenhorst, 1829) (Amphibia, Anura, Ranidae) and related species. 2. morphological and molecular variation in frogs from the Greater Sunda Islands (Sumatra, Java, Borneo) with the definition of two species. Alytes, 19: 5–28.
- Wiens, J.J., J. Sukumaran, R.A. Pyron, and R.M. Brown. 2009. Evolutionary and biogeographic origins of high tropical diversity in old world frogs (Ranidae). Evolution, 1217–1231.

Manuscript received 10 June, 2011; revised 15 July 2011; accepted 24 December, 2011

PLEASE NOTE:

The publisher is not responsible for the content of any materials supplied by the author. Any queries should be directed to the corresponding author (sajidpabc@gmail.com) for the article.

BONNOPRANI

Biannual and Bilingual (English and Bangla) Publication in Zoological Science.

EDITOR: Ghazi S. M. Asmat, Department of Zoology, University of Chittagong, Chittagong 4331, Bangladesh.
E-mail. gasmal@gmail.com

BONNOPRANI will take advantage of the rapidly evolving medium of quick online publication from the next issue. It is an appropriate and viable medium for the publication of standard papers in all aspects of zoological science. Research papers and notes, Review papers and notes, country records, distribution notes, descriptions of new taxa, faunistic surveys, lists of museum collections, abstracts of theses and research projects, book reviews, and 'views on news' related to any environmental issue are welcome.

BONNOPRANI has selected the following libraries/museums in which the print-on-paper originals will be kept.

1. ZR, Zoological Record, York, UK
2. LC, Library of Congress, Washington, DC, USA
3. USNM, United States National Museum of Natural History (Smithsonian Institution), Washington, DC, USA
4. AMNH, American Museum of Natural History, New York, USA
5. CAS, California Academy of Sciences, San Francisco, USA
6. FMNH, Field Museum of Natural History, Chicago, USA
7. MCZ, Museum of Comparative Zoology, Cambridge, Massachusetts, USA
8. MNHN, Museum National d'Histoire Naturelle, Paris, France
9. NMW, Naturhistorisches Museum Wien, Vienna, Austria
10. BMNH, British Museum of Natural History, London, England, UK
11. MZUC, Museo Zoologico "La Specola" dell'Universita de Firenze, Florence, Italy
12. ZISP, Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia
13. WAM, Western Australian Museum, Perth, Australia
14. NTNU, Norwegian University of Science and Technology, Trondheim, Norway
15. NLC, National Library of China, Western Language Publications Acquisitions Section, Beijing, China
16. ZSI, Zoological Survey of India, New Alipore, Kolkata, India
17. IUCN Red List Unit, Cambridge, UK
18. OUMNH, Oxford University Museum of Natural History, Parks Road, Oxford, UK
19. NLSA, National Library of South Africa, Cape Town, South Africa

ADDRESS FOR CORRESPONDENCE

THE PUBLISHER

BONNOPRANI- Bangladesh Wildlife Bulletin
House # 160, Road # 2, Block C
Sugandha Residential Area
Panchlaish, Chittagong 4203
BANGLADESH

E-mail: bonnoprani@gmail.com